

Study of the $^{208}\text{Pb}(^{48}\text{Ca},2n)^{254}\text{No}$ reaction

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The $^{208}\text{Pb}(^{48}\text{Ca},2n)^{254}\text{No}$ reaction was studied to obtain an excitation function that could be used to compare the operation of the Berkeley Gas-filled Separator (BGS) with other compound nucleus evaporation residue (EVR) separators around the world.

The calcium on lead reaction is used because the doubly magic projectile and target lead to a very low excitation energy in the compound nucleus of approximately 23 MeV, leading to a relatively large cross section of a few microbarns for the $^{208}\text{Pb}(^{48}\text{Ca},2n)^{254}\text{No}$ reaction [1].

$^{48}\text{Ca}^{10+}$ was accelerated by the 88" Cyclotron at an average beam current of approximately 200 enA. The target system consisted of a rotating wheel composed of nine $453\text{ }\mu\text{g}/\text{cm}^2$ ^{208}Pb targets. Energies in the center of the ^{208}Pb target varied in the lab frame from 210.2 MeV to 222.7 MeV. After the evaporation residues left the target, they traversed the BGS at a pressure of 0.742 torr of He and were focused onto the focal plane detector. The evaporation residues and α -decay from ^{254}No (8.09 MeV) were detected with a position-sensitive silicon-strip detector. The production cross section at each energy was obtained from the integrated ^{254}No peak, average beam integral and the known BGS efficiency of 45% and detector efficiency of 50% (Figure 1). These results look good when compared to HIVAP evaporation codes and are similar to previous research [1].

The half-life of ^{254}No ($t_{1/2} = 55 \pm 3$ s [2]) was also determined. By examining correlations in time and position between evaporation residue implantation in the silicon-strip detector and 8.09 MeV α -decays, the decay curve in figure 2 was generated. An MLDS (Maximum Likelihood of Decay by the Simplex method) fit to the decay curve gives a ^{254}No half-life of 50 ± 6 seconds. This agrees with the literature value of 55 ± 3 seconds.

References

1. H.W. Gäggeler et al., GSI Scientific Report 1988, 18 (1989).
2. LBNL/LUND Table of Radioactive Isotopes 1999, <http://nucldata.nuclear.lu.se/nucldata/toi/>

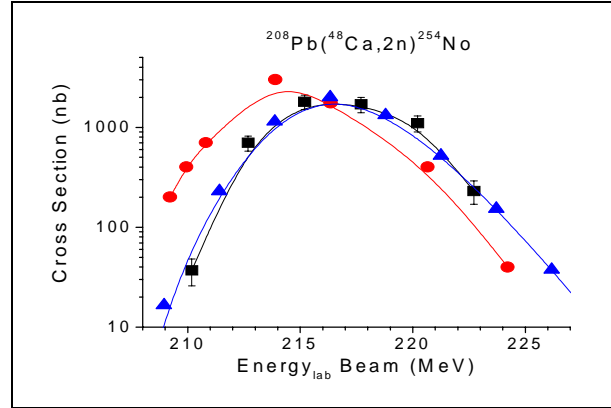


Fig. 1. Excitation function for the $^{208}\text{Pb}(^{48}\text{Ca},2n)^{254}\text{No}$ reaction. Experimental data (black squares), previous experimental data (red circles), and HIVAP predictions (blue triangles) are noted.

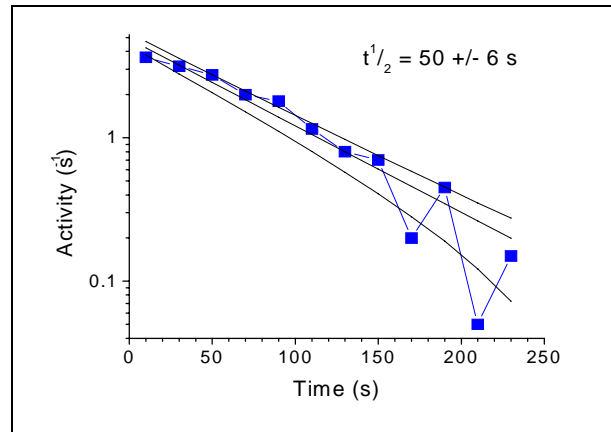


Fig. 2. Decay curve and MLDS fit to the ^{254}No EVR – α -correlation data.